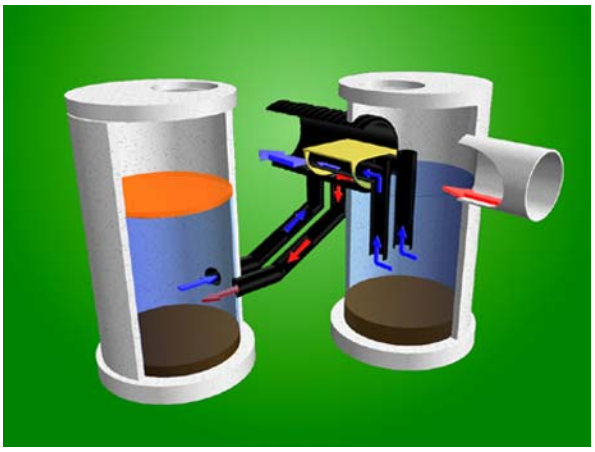
5.1. Swirl Separators

5.1.1. BaySaver

General Description



The BaySaver system is comprised of two precast concrete manholes and a high-density polyethylene (HDPE) separator unit. It relies on gravity sedimentation and flotation to remove and retain the collected contaminants. The BaySaver works as the dual settling chambers and internal flow splitter act in tandem to provide different levels of treatment for different runoff intensities. Coarse sediments are removed in the first structure, and the finer sediments and floating pollutants are removed and trapped in the second during periods of low flow that comprise most storm events. During more intense storms, the elbow pipes draw water from below the surface in the first manhole. This water is free of floatable pollutants, and suspended sediments have had time to settle out. At moderate flow rates, the elbow pipes draw water from the center of the first manhole and discharge it directly downstream. The concrete manholes are cast to the applicable specifications by local precasters.

Site Considerations

The BaySaver Separation System is a water quality unit that targets and removes suspended sediments, free oils, floating debris, and other pollutants from stormwater runoff. The BaySaver System can be used to improve the quality of stormwater runoff from high traffic areas, to contain potential spills, as a pretreatment step in a longer treatment process, and for numerous other applications. Specific potential uses include:

- High traffic parking lots
- Gas and service stations
- Spill control for potential hotspots
- Industrial maintenance facilities
- Highway stormwater runoff
- Pretreatment practices to increase longevity of already installed traditional or innovative BMPs

The BaySaver units come in three standard sizes depending on the treatment flow and drainage area able to be treated by each unit. Table 5.2 below summarizes the unit sizes and treatment capacities.

Table 5.2. Unit size and treatment capacities for BaySaver systems..

Separator Unit	Unit Diameter	Manhole Size	Treatment Flow	Bypass Flow	Treatable Drainage Area
1K	24”	48”	2.4 cfs	8.8 cfs	1.2 – 1.6 acres
3K	36”	60”	7.2 cfs	24 cfs	1.6 – 4.4 acres
5K	48”	72”	11 cfs	39 cfs	4.4 – 8.0 acres

The BaySaver separator unit includes an internal bypass that discharges high flow rates directly downstream without treatment during intense flows to avoid flooding.

Installation

The BaySaver systems are most easily installed at the same time as the storm drain, but can be retrofitted for existing pipes. The manholes are standard structures, and the BaySaver is joined to each structure using standard storm drain connections. No pretreatment is required for the BaySaver system.

Maintenance

The BaySaver must be periodically maintained. Maintenance is conducted with a vacuum truck, and consists of removing the accumulated pollutants. Both inspection and maintenance can be done above ground, without confined space entry. Maintenance requires only partial removal of the stored water thus reducing disposal costs. The manufacturer states that the BaySaver will continue to treat stormwater runoff as long as it is adequately maintained.

Aesthetics, Community and Safety

Concerns regarding aesthetics, community support, and safety are highly site specific. For further information refer to Chapter 2, Decision Criteria.

Cost

Material and installation cost estimates for the different systems are shown below in Table 5.3. Treatment costs range from $3000 to $8000 per acre, depending on the system size and contributing drainage area.

Table 5.3. Material and installation cost estimates for BaySaver systems.

	1K System	3K System	5K System
Separator Unit	$3990	$5990	$7990
Primary Manhole (estimated)	$900	$1900	$2600
Storage Manhole (estimated)	$1000	$2000	$2700
Installation Cost (estimated)	$3000	$4000	$5000
Total System Cost	$8890	$13,890	$18,290

Performance and Verification Ranking

Verification Ranking: ♦♦

Several studies are currently underway for the BaySaver System. Previous studies have shown TSS removal efficiencies of between 78%-88%. Please contact the manufacturer for updates.

Studies:

- *Recap of TSS Removal Tests Performed by the University of Maryland and by BaySaver, Inc*. Hillis Carnes Engineering Associates. BaySaver, Inc. August 1997.

Installation Contact

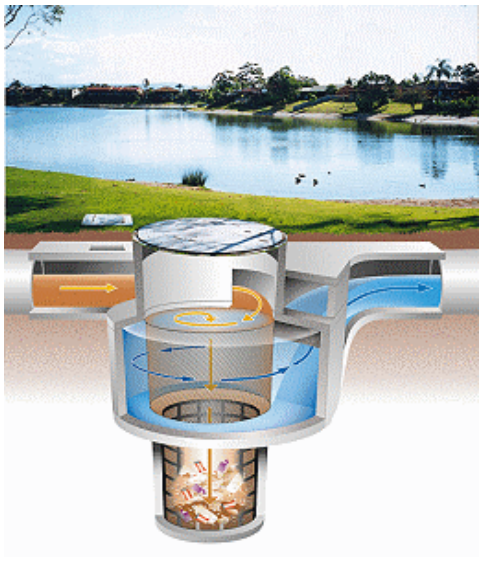
Location: Hooksett Sunoco Station
1248 Hooksett Rd. US Rt. 3
Hooksett, NH
Date Installed: Fall 2001
Contact: Sean McDonald
Northeast Earth Mechanics, Inc.
175 Barnstead Road
Pittsfield, NH 03263
Tel: (603) 435-7989
Email: seanm@neearth.com

Manufacturer

Company: BaySaver, Inc
Address: 1010 Deer Hollow Drive
Mount Airy, MD 21771
Telephone: (301) 829-6407 or (800)-BAYSAVE
Fax: (301) 829-3747
Website: www.baysaver.com
Contact: Mark Hausner

5.1.2. Continuous Deflective Separation (CDS) Unit

General Description



The Continuous Deflective Separation (CDS) technology uses fluid dynamics to effect a separation of solids from liquids. CDS offers precast standard size units or cast-in-place units specifically designed for individual site conditions. The unit is designed to set up a continual flow of liquid that passes over the face of the screen in a hydraulically balanced separation chamber. Solids are captured and retained within the central chamber and the fluid passes through the screen and exits via the outlet pipe. Solid pollutants are retained in a centrally located solids catchment chamber with the heavier solids ultimately settling into the base of the unit or sump.

Site Considerations

The CDS unit is designed for the removal of gross stormwater pollutants. It targets and removes trash, debris, vegetative material and coarse sediments prior to discharge to receiving waters and wetlands. Applications include parking lot runoff treatment to control trash and debris and low levels of oil and grease when absorbents are added to the separation chamber. CDS can provide protection of stormwater pumping facilities and work well for redevelopment and retrofit for ultra-urban applications. Specific potential uses include:

- Commercial service and parking areas
- Industrial areas
- Public property and parkland
- Residential streets and private property

The recommended design flows for the CDS units are typically those with a return frequency of 3 to 6 months. These flows are normally in excess of those required to generate movement of pollution typically associated with "first flush" events. However, should higher flows be identified as movers of pollution in a particular watershed, CDS capacity should be treated accordingly. CDS units are capable of treating flows ranging from 0.7 cfs to 300 cfs.

Installation

CDS Units are compact and installed below ground. In general, a CDS unit occupies about 4 ½ square feet of plan view area for each cfs that it treats, with the bulk of the plan view area being well below grade. CDS personnel will be onsite during installation to assist the owner or contractor. Pretreatment is not required for CDS Unit operation. The CDS Unit can be used as a pretreatment for other traditional or innovative BMPs. Specific installation details can be obtained through manufacturer contact.

Maintenance

The maintenance requirements and cost of the CDS unit in stormwater applications is highly site specific depending on the level of development within and characteristics of the watershed and the generation of floatable trash and debris and settable material.

Preventative maintenance cleanout schedules can be developed based on periodic inspections and experience with the operation of the CDS unit. The units typically require cleanout of accumulated material four times annually when the technology serves a developed urbanized area. The cleanout of the sump is a critical component of a successful operation and performance of the CDS unit because the sump is the depository for all captured settleable pollutants. The standard models are provided with a standard size cleanout sump that can be cleaned by methods determined by the client. The method for cleanout is generally client-specific depending on the equipment available for the sump cleanout and size of the unit.

CDS Technologies recommends that a clamshell bucket be utilized for CDS Models CSW150 (15' in diameter) and larger, and that vacuum truck systems, baskets or small clam bucket be utilized for cleaning smaller units. The smaller CDS units should be dewatered prior to cleaning when using vacuum techniques. These methods have been found to be most cost-effective; however, vacuum removal can be relatively slow due to blockages in the suction hose when the sump contains a high content of sticks and branches.

CDS Technologies recommends the following maintenance procedures for stormwater applications:

- New Installations: Check the condition of the unit after every runoff event for the first 30 days. This should include a visual inspection to ascertain that the unit is functioning properly and measuring the amount of deposition that has occurred in the sump and depth of floatable material. This can be performed using a "dip stick" that is calibrated so the depth of the deposition can be tracked.

- Ongoing Operation: During the wet weather season, the unit should be inspected at least once every 30 days. The floatables should be removed and the sump cleaned when the sump is above 85% full. At least once a year, the unit should be pumped down and the screen should be carefully inspected for damages and to ensure that the screen is properly fastened. Power washing of the screen is recommended prior to inspection.

Maintenance requires vehicle access for the removal of trash and debris and sediment. CDS will provide maintenance service of the units through contracts and support the initial year of maintenance inspections.

Aesthetics, Community and Safety

Concerns regarding aesthetics, community support, and safety are highly site specific. For further information refer to Chapter 2, Decision Criteria.

Cost

The cost of precast CDS units range from $15,700 for a 3 cfs unit to $61,800 for the 26 cfs unit delivered to the job site. The equipment costs of the precast units per cfs treated ranges from $2,377 to $5,233. Installation costs are site-specific depending on the need to relocate utilities, working space and depth of installation, but are typically approximately ½ to 1 times the unit cost.

Cleanout costs are user-specific and vary according to the amount and types of debris, floatables, and sediment captured by the CDS unit, safety requirements for the area of operation, equipment utilized, disposal costs and personnel costs.

Units installed to date are being cleaned using a vactor system being operated by the system operator. Table 5.4 shows the average costs of collection baskets and vacuum removal for maintenance based on the unit model.

Table 5.4. CDS average costs of collection baskets and vacuum removal based on model.

CDS Model	Collection Basket	Vacuum Removal
P30 (3' diameter)	$500	$400
P70 (7' diameter)	$750	$525
P100 (10' diameter)	$900	$675
P150 (15' diameter)	$1200 – 1450 using clam shell technique	

Performance and Verification Ranking

Verification Ranking: ♦♦♦

Studies:

- *Continuous Deflection Separation (CDS) Unit for Sediment Control in Brevard County, Florida*. Brevard County Surface Water Improvements. July 1997.

Trash and Debris:

The design features of the CDS unit, and previous installations confirm that the system captures and retains 100% of the trash, debris and particulates in stormwater larger than the minimum screen aperture size (0.048 – 0.185 inches), as well as a very high percentage (>90%) of material down to 1/3 of the screen aperture.

Total Suspended Solids:

Independent laboratory tests on prototype units conducted by the Department of Civil Engineering at Monash University in Australia indicate that the CDS unit traps virtually 100% of the particulate material ½ the aperture size and >90% of the particulates 1/3 of the aperture size. A 2400-micron (0.096-inch) screen achieved 95% removal of particles of 800 micron (coarse sand) and 50% removal of particles of 475 micron (medium sand).

The cleanout of a CDS unit found that approximately 26% of the material removed is gross liter, 39% vegetative matter and 35% inorganic matter. Over half of the sediment collected was less than 200 microns (medium sand) and 11% less than 50 micron (silt). These removals are in part attributed to finer material attached to larger particles and higher removal efficiencies that occur during lower flows.

Oil and Grease:

The CDS units are not specifically designed nor have been extensively tested for removal of oil and grease; however, oil and grease attached to floating debris (Styrofoam, etc) and attached to sediments will be captured and retained. The design features of the separation chamber will retain floating oil and provides an area where sorbent material can be applied and dispersed to achieve maximum contact with floating and emulsified oil and grease.

CDS Technologies has contracted for additional research and development work by the Commonwealth Scientific, Industrial and Research Organization (CISRO) and the Department of Civil Engineering, Monash University in addition to its own research and development facilities. The USEPA Wet Weather Research Program is conducting a test of the CDS CSO application as part of the studies at Rockland County, New

York. Effectiveness of the CDS system to remove sediments and oil and grease using absorbent material in the separation chamber is being evaluated at UCLA and the fin particle separation capability of the CDS unit is being evaluated at Portland State University.

Installation Contact

Location: The Sewerage Works Improvements-Temple Street Area
Nashua, NH
Date Installed: January 2002
Contact: Alan LeBlanc PE, Design Engineer
Camp Dresser & McKee, Inc.
1001 Elm Street, 2nd Floor
Manchester, NH 03101-1845
Tel: (603) 222-8380

Additional Installations Include:

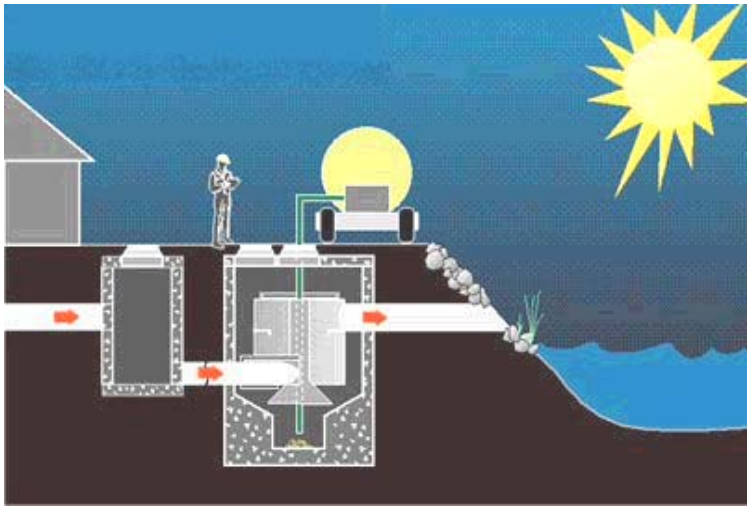
- Crystal River, FL
- Santa Monica, CA
- Australia
- New Zealand

Manufacturer

Company: CDS Technologies
Address: PO Box 249
Ashburnham, MA 01430
Telephone: (978) 827 2378
Fax: (978) 827-2388
Email: nreitzal@CDStech.com
Website: www.CDStech.com

5.1.3. Downstream Defender™

General Description



The Downstream Defender™ is a treatment device provided by Hydro International that augments gravitational forces with vortex forces to maximize solids/liquids separation. The Downstream Defender™ is self-activating and operates on fluid hydraulics. The geometry of the internal components and placement of the inlet and outlet pipes are designed to direct the flow in a pre-determined path through the vessel. Stormwater is introduced tangentially into the side of the vessel and initially spirals around the perimeter, where oil and floatables rise to the water surface and are trapped. As the flow continues to rotate about the vertical axis, it travels down toward the bottom of the dip plate. Sediment is directed toward the center and base of the vessel where it is collected in the sediment storage facility, beneath the vortex chamber. The center cone protects stored sediment and redirects the main flow upwards and inwards. By the time the flow reaches the top of the vessel, it is virtually free of solids and is discharged through the outlet pipe.

Site Considerations

The Downstream Defender™ was engineered to target and capture settleable solids, floatables, oil and grease from stormwater runoff. Specific potential applications include:

- New development and retrofits
- Construction sites, industrial and commercial facilities
- Streets, roadways, and parking lots
- Vehicle maintenance wash-down yards
- Wetlands protection

Four standard sizes are available; each designed to treat a range of flows to a specific solids removal efficiency. Hydro International also offers custom designed units up to forty feet in diameter to meet specific performance criteria or for larger flow applications. Table 5.5 shows the design specifications for each standard unit.

Table 5.5. Design specifications for the Downstream Defender™ standard units.

Unit Diameter	Design Flow(1)	Design Capacity (2)	Oil Storage Capacity	Sediment Storage Capacity
(feet)	(cfs)	(gpm)	(gallons)	(cubic yards)
4	0.78/3.0	330/1,350	70	0.70
6	3.00/8.0	1,350/3,590	230	2.10
8	7.00/15.0	3,140/6,730	525	4.65
10	13.0/25.0	5,830/11,220	1050	8.70

Installation

The Downstream Defender™ is delivered to the site completely fabricated, ready to be installed into the excavated hole and connected to the inlet and outlet piping. The unit is compact and can fit within an excavation trench guard. It consists of a concrete cylindrical vessel with polypropylene internal components and a stainless steel support frame. The concrete vessel is a standard manhole, installed below grade. Larger units are delivered to site in component form for final assembly at the job site. Installation time for a 6-foot unit is typically 1.5 hours. The Downstream Defender™ is a primary treatment device that requires no pretreatment. It can be used as a pretreatment device before detention systems, mitigating wetlands, or other polishing systems.

Maintenance

The Downstream Defender™ should be installed in a location that is easily accessible for a maintenance vehicle, preferably in a flat area close to a roadway or parking area. Two ports at ground level provide access for inspection and cleanout of stored floatables and sediment. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables. Floatables and oil should be removed prior to removal of sediment.

The frequency of maintenance is determined in the field, after inspection. During the first year of operation, the unit should be inspected every six months to determine the rate of sediment and floatables accumulation. A probe can be used to determine the level of solids in the sediment storage facility. When the sediment has accumulated to the specified depth, the contents should be removed by sump-vac. In most situations, it is recommended that the units be cleaned annually.

Although a small portion of the water is removed with the pollutants during the cleanout process, the units are typically not completely dewatered – minimizing disposal costs. The sump-vac procedure for a typical 6-foot diameter unit with one foot of sediment depth and two inches of oil and debris takes approximately 25 minutes and removes about 150 to 200 gallons of water in the process.

With regular maintenance, the Downstream Defender™ will treat stormwater for a period in excess of 30 years.

Aesthetics, Community and Safety

Concerns regarding aesthetics, community support, and safety are highly site specific. For further information refer to Chapter 2, Decision Criteria.

Cost

The Downstream Defender™ ranges in price depending unit size. The prices are as follows:

4’- diameter	$10,200
6’- diameter	$13,000
8’- diameter	$19,000
10’- diameter	$29,600

Performance and Verification Ranking

Verification Ranking: ♦♦♦♦

Typical testing results show removal efficiencies of over than 90% of particles greater than 150 microns. Full-scale test results show settleable solids removal efficiencies of 90% at design flows. Because the sediment and oil storage areas are outside the main flow path through the unit, previously collected solids, oil and floatables are not re-entrained in the effluent during major storm events or surcharge conditions. In addition, treatment capacities are not reduced as pollutants accumulate between cleanouts.

Studies:

- *Swirl Concentrator Testing at Pinehurst Redmond, Washington*. Talaseae Consultants. October, 1999.
- The School of the Built Environment, Coventry University
- *State of Maine Performance Data and Testing Protocols Review*. April 1997 – September 1998.

Installation Contact

Location: Shop N' Save Plaza, Manchester, NH
Contact: Art Grindle, Manchester Urban Pond Restoration Coordinator
City of Manchester
One City Hall Plaza
Manchester, NH 03101
Telephone: (603) 624-6450
Email: agrindle@ci.manchester.nh.us

Manufacturer

Company: Hydro International
Address: 94 Hutchins Drive
Portland, ME 04102
Telephone: (207) 756-6200
Fax: (207) 756-6212
Email: hiltech@hil-tech.com
Website: www.hil-tech.com
Local contact: David Mongeau, Regional Sales Engineer
Email: dmongeau@hil-tech.com

5.1.4. Stormceptor®

General Description

The Stormceptor® is a precast modular structure that can be installed on existing or new storm drain systems. Its design prevents the resuspension or scouring of previously collected pollutants and it will not flush out previously collected materials during peak stormwater flow periods. The Stormceptor® units are made out of either fiberglass or precast concrete depending on site conditions.

Site Considerations

The Stormceptor® is designed for the removal of free-floating oil, grease, and sediments. It can be used as a primary water quality device, a pretreatment device, a spill control device, a coastal zone management device, or a stormwater device. The Stormceptor® is best suited for drainage areas less than 10 acres. The fiberglass units are typically lighter in weight than the precast concrete units, and are chemically inert making them more suitable for installation at industrial sites, fuel tank farms, service stations, and restaurant parking lots. The precast concrete units are more suitable for residential subdivisions, commercial parking lots, and on roadway and highway margins.

The Stormceptor® is available in a choice of materials depending on treatment needs and site conditions. Dimensions of the systems vary from the Model STC900, which treats up to 285 gpm with a total holding capacity of 950 gallons, to a Model STC 7200, which treats up to 1110 gpm with a total holding capacity of 7415 gallons.

Installation

The Stormceptor® is assembled from precast modular components. Typically installation takes from several hours to ½ day. Installation is below grade. The Stormceptor® does not require any pretreatment and can be used as a pretreatment device for TSS removal and as a spill control device for removing oil and grease.

Maintenance

It is recommended that material in the storage section be pumped out annually by a vacuum truck, although monitoring may indicate that the unit needs less frequent service. Typical cleaning costs are estimates at approximately $250, with disposal costs averaging $300 to $500. The absence of filtering media reduces the difficulty of maintenance. Stormceptor® units have an expected life of 50 to 100 years.

Aesthetics, Community and Safety

Concerns regarding aesthetics, community support, and safety are highly site specific. For further information refer to Chapter 2, Decision Criteria.

Cost

The cost of the Stormceptor® ranges from $7600 for the STC 900 unit to $33,560 for the STC 7200 unit. This price structure is for the entire unit, including lubricants and gaskets, flexible pipe connectors, and an HS20 Stormceptor® ring and lid. This price is not dependent on the height of the structure.

Performance and Verification Ranking

Verification Ranking: ♦♦♦♦♦

A variety of performance testing has been conducted on the Stormceptor®. Laboratory and field testing have shown removal efficiencies of 80% for TSS and 95% for free oil and hydrocarbon spills.

Studies:

- *Field Monitoring Results Seatac, Washington*. Associated Earth Sciences, Inc. March – October, 1999.
- *Field Monitoring Results Westwood, Massachusetts*. Environmental Sampling and Technology. July-November, 1997.
- *The School of the Built Environment Coventry University Stormceptor Report*. Coventry University. May-August, 1996.
- *Field Monitoring Results – Update Como Park, Minnesota*. Service Environmental and Engineering. August, 1998 – September, 1999
- Massachusetts Strategic Envirotechnology Partnership (STEP) Program Stormceptor Report. December 1997.
- Stormceptor ¼ Scale Laboratory Test National Water Research Institute. 1993, 1994.
- *Wisconsin Stormceptor Field Monitoring Summary*. Wisconsin Department of Natural Resources and US Geological Survey. August 1996 – April 1997.
- *Field Monitoring Results City of Edmonton, Alberta*. The Phoenix Group. 1994.
- *Sludge Analysis and Particle Size Distribution City of Orlando, Florida*. City of Orlando. June, 2000.

Installation Contact

For information of installation contacts and updates please contact Rinker Materials. The following is a list of Stormceptor installation sites in New England:

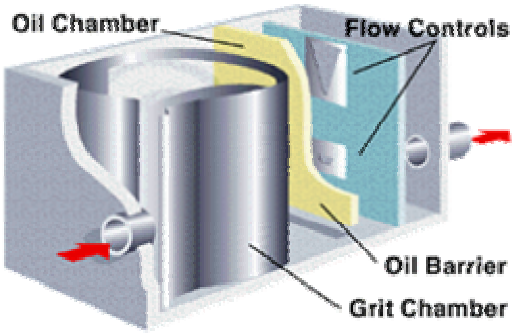
Allenstown, NH
Durham, NH
Highland Ave, Hampton, NH
Old Navy Store, Nashua, NH
Gilmore Bridge, Boston, MA
University Ave, Westwood, MA
South Bay Complex, Boston, MA
Summerfield Suites, Burlington, MA
Cardinal Honda, Groton, CT
Clinton Crossing, Clinton, CT
EPA Superfund Site, Stratford, CT

Manufacturer

Company: Rinker Materials
Hydro Conduit Division
Address: 69 Neck Road
Westfield, MA 01085
Telephone: (800) 909-7763
Fax: (816) 802-3871
Website: www.rinkerstormceptor.com
Contact: Jim Donovan, P.E., Stormceptor Marketing Manager
Email: jdonovan@rinker.com

5.1.5. Vortechs™ Stormwater Treatment System

General Description



The Vortechs™ Stormwater Treatment System is designed to treat stormwater runoff from urban and other areas with impervious surfaces that threaten to drain pollutants into watersheds and other ecologically sensitive areas.

The Vortechs™ units are fabricated of a precast Portland cement mixture with a tangential inlet to the trap's circular grit chamber where stormwater is channeled into a vortex-like flow path. This swirling action directs sediment into the center of the chamber, where it accumulates. A sealed oil barrier then traps oily contaminants floating in the grit chamber. This combination of swirl-concentrator and flow-control technologies work to abate forces that encourage resuspension and washout.

Site Considerations

The Vortechs™ system is designed to remove and retain sand, hydrocarbon-laden sediments, petroleum-based liquids, and other floatable and settleable debris from stormwater runoff. Vortechs™ systems have been installed in a variety of residential, industrial, commercial, and municipal applications. Specific potential applications include:

- Parking lots
- Airport runways
- Roadways
- Vehicle maintenance areas
- Gas stations
- Outdoor material storage areas

Each Vortechs™ system is custom-designed to suit individual site conditions. Nine standard models of the Vortechs™ system are available. Treatment capacities range from the Model 1000, which treats up to1.6 cfs, to the Model 16,000, which treats up to 25 cfs. Large flows can be accommodated using a combination of standard models with custom-sized or cast-in-place systems.

Installation

The Vortechs™ system is made of a precast Portland cement mixture. The circular grit chamber, and weir and orifice plates located on the flow-control wall, are fabricated separately of aluminum and installed by the precaster. Each Vortechs™ system also includes manhole frames and covers. Dimensions of the units range from the Model 1000, which is 9'l x 3'w x 6'h, to the Model 16,000, which is 18'l x 12'w x 8'h.

The Vortechs™ system is installed below grade. Installation time is approximately 3 hours. The excavation floor is leveled and lined with gravel or other granular material, and the Vortechs™ system housing and its components are lowered into place. Joints are then sealed, inlet and outlet piping are set in place, a cover is placed over the system and sealed, and the excavation is filled. Since each system is custom-engineered, inlet and outlet configurations can be modified to suit site conditions. Pretreatment of runoff before it enters the Vortechs™ system is not necessary in most cases.

Maintenance

The system's flow controls cause water to decant at a controlled rate after a storm event, leaving a low water level. This, combined with the system's large pollutant storage capacity, results in a low water-to-pollutant ration. This typically reduces the cost and frequency of maintenance. Vortechnics recommends seasonal inspections during the first year of operation to establish an appropriate maintenance schedule. Typically the system is cleaned once per year depending upon weather and site activity. It is recommended that the maintenance schedule for New England installations include cleanout just prior to the winter sanding/salting season.

With regular maintenance the Vortechs™ system is designed to provide indefinite stormwater treatment. There are no moving parts, filters, bags, or other components that need to be replaced.

Aesthetics, Community and Safety

Concerns regarding aesthetics, community support, and safety are highly site specific. For further information refer to Chapter 2, Decision Criteria.

Cost

The cost of the Vortechs™ system ranges from approximately $8,900 for the model 1000 to $40,000 for the model 16000. An additional 30% for the smaller units and 50% for the larger units can be estimated for installation costs. Sizing and pricing the system is done on an individual basis to accommodate local site conditions and treatment requirements; contact Vortechnics for assistance with sizing and pricing for specific projects. Prices include manhole frames and covers, but exclude risers (if needed) and excavation and installation costs. Typically the site contractor, who can provide cost estimates for these services, undertakes the latter two items.

Performance and Verification Ranking

Verification Ranking: ♦♦♦♦♦

Laboratory studies of the Vortechs™ system showed a "net" total suspended solids (TSS) removal efficiency rate over the course of storm events of over 80%. In-field monitoring and testing is ongoing; preliminary test results are available from Vortechnics upon request.

Studies:

- *Vortechnics Stormwater Treatment Study.* Susan Kluk, University of Connecticut. January 1998 to August 2000.
- *A Study of the Effectiveness of a Vortechs Stormwater Treatment System for Removal of Total Suspended Solids and Other Pollutants in the Marine Village Watershed, Village of Lake George, New York.* NYS Department of Environmental Conservation Division of Water. January 2001.
- *Stormwater Treatment Demonstration Project Oil Water/Grit Separator followed by a Sand Filter*. Harding Township, NJ. A. Roger Greenway, RTP Environmental Associates.
- *Technology Assessment Report Vortechs Stormwater Treatment System Vortechnics, Inc.* Scarborough, ME. Prepared for Massachusetts Strategic Envirotechnology Partnership (STEP). Eric Winkler, Ph.D. and Susan Guswa, PE. October 31, 2002.

Installation Contact

Location: Mast Landing, Wolfeboro, NH
Date Installed: November, 2000
Contact: Marty Bilafer, Director of Public Works
PO Box 629
Wolfeboro, NH 03894
Tel: (603) 569-8176

Additional Installations:
Lake Tahoe, CA
Lake Beseck, Middlefield, CT
Penobscot River, Bangor, ME
Ropes Beach, Cotiut, MA
Lake Williams, Marlborough, MA
Jones River, Kingston, MA
Lake of the Lillies, Point Pleasant, NJ
Lake Winnipesaukee, Meredith, NH
Dublin Lake, Dublin, NH

Manufacturer

Company: Vortechnics, Inc.
Address: 200 Enterprise Drive
Scarborough, Maine 04074
Telephone: (207) 885-9830
Fax: (207) 885-9825
Website: www.vortechnics.com

5.1.6. HYDRASEP®

General Description

The Hydrasep® oil/water separator is designed to operate as a flow through device and to separate immiscible liquids by gravity in either a batch flow or continuous flow process. The contaminated liquid is introduced into the inlet or Mixing Chamber where heavy solids are allowed to settle. The flow then enters into the Separator Chamber, which consists of a series of channels, sub-divided into multiple parallel sub-channels. These serpentine channels direct the flow and eliminate turbulence. The transfer pipe connecting the separator section to the clean water section regulates and dampens fluid accelerations, causing the separator to act as an accumulator. The Oil Section is a separate area for retention and removal of accumulated oils without interfering with the operation of the separator. The Clean Water Section is designed for gravity discharge of water.

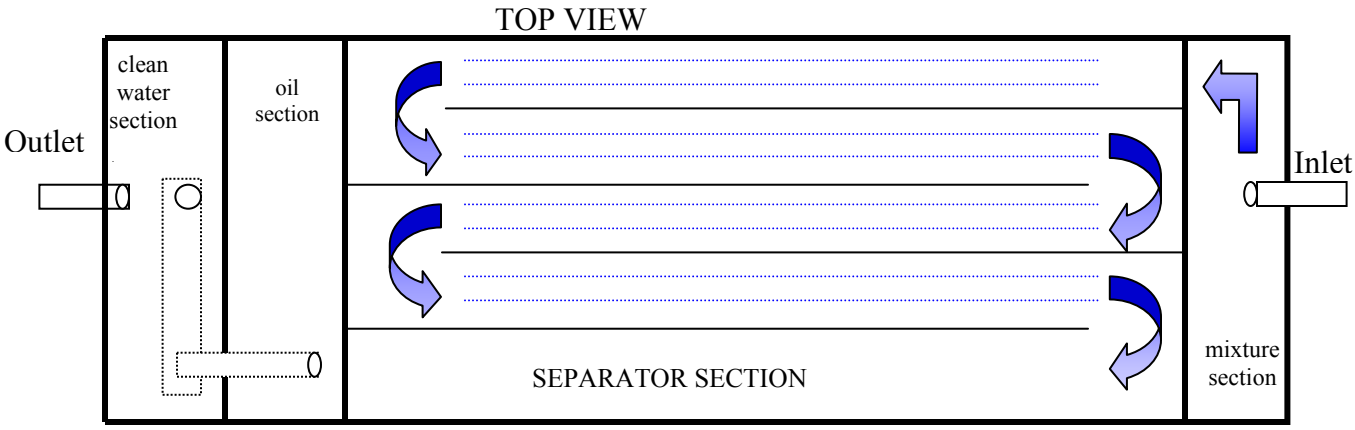


Figure 5.1. Top view of HYDRASEP Rectangular Oil/ Water Separator.

Site Considerations

The Hydrasep® system is designed to target and remove oil and grease from stormwater runoff. The Hydrasep® can be used for a variety of applications requiring gravity separation of immiscible liquids. Specific potential applications include:

- Railroads, airports, and bus terminals
- Truck stops
- Parking lots
- Marinas and dock operations
- Municipal vehicle and Industrial facilities

The Hydrasep® Oil/Water Separator is available in a variety of models depending on individual site conditions. Models include: the Effluent Pump-Out Model, the Combination Interceptor and Oil/Water Separator Model, the Oil/Water Separator Model, and the Grade Service Access Model. Hydrasep® systems can treat a range of flows from the Model HS 550-UG, which treats flows up to 55 gpm and holds up to 550 gallons, to the Model HS 20,000-UG, which treats flows up to 2,000 gpm and holds up to 20,000 gallons.

Installation

The Hydrasep® Underground Oil/Water Separators are constructed of corrosion-protected steel and are installed below grade. The units range in size from the Model HS 550-UG, which is 3'6" in diameter and 8'2" in length, to the Model 20,000-UG, which is 9'3" in diameter and 40'4" in length. No pretreatment is required for the Hydrasep® system.

Maintenance

Gnesys recommends monthly inspections of the control unit, and an annual visual inspection of the separator. This annual inspection requires the removal of three manway hatches and observation of the liquids within these sections. The annual inspection should take 30 to 60 minutes, depending on the type and location of the installation.

Aesthetics, Community and Safety

Concerns regarding aesthetics, community support, and safety are highly site specific. For further information refer to Chapter 2, Decision Criteria.

Cost

The average cost of the Hydrasep® system Model HS 1000-UG is $9,000.00.

Performance and Verification Ranking

Verification Ranking: ♦♦♦

Testing of the Hydrasep® Oil/Water separator has shown removal efficiencies of over 99.9% of oil and grease. Testing has shown that Hydrasep® maintains efficiency with mixtures up to 500,000 parts per million (ppm), and has shown performance of 10 ppm or less.

Studies:

- The University of Memphis. Global Engineering Consultants. 1995.

Installation Contact

No existing New Hampshire installations to date. For contact information of installations outside of New Hampshire and for updates please contact Gnesys, Inc.

Manufacturer

Company:	Gnesys, Inc.
Address:	2147 Frisco Avenue Memphis, TN 38114
Telephone:	(800) 646-5439 or (901) 745-4503
Fax:	(901) 745-4507
Email:	sales@hydrasep.com
Website:	www.hydrasep.com
Contact:	Naji Nassif, PhD

5.1.7. Aqua-Swirl™ Concentrator

General Description

The AquaSwirl™ Concentrator is a swirl separator typically installed in an "off-line" configuration. Stormwater enters the swirl concentrator by means of a tangential inlet pipe that creates a circular flow pattern. A combination of gravitational and hydrodynamic drag forces cause solids to drop out of the flow and migrate to the center of the chamber where velocities are lower. The velocity gradient created by the swirling action prevents solids from being re-suspended.

Site Considerations

The AquaSwirl™ Concentrator targets and removes sediment and free-floating oil and debris from stormwater runoff. Specific potential applications include:

- Retail/commercial developments
- New and existing industrial facilities
- Highway and transportation facilities
- Watershed protection
- Redevelopment/retrofit sites
- Fast food restaurants
- Coastal communities

The AquaSwirl™ Concentrator is fabricated using High-Density Polyethylene (HDPE) materials. Table 5.6 below shows the standard AquaSwirl Models and the associated treatment and storage capacities.

Table 5.6. AquaSwirl models and associated treatment and storage capacities.

Aqua-Swirl™ Model	Peak Design Storm Flow (i.e. Q10-yr) (cfs)	Swirl Chamber Diameter (ft)	Approximate Impervious Area Treated (acres)	Oil Storage Capacity (gal)	Sediment Storage Capacity (yd^3)
AS-3	5.25	3.5	0.00 – 0.75	85	0.75
AS-4	10.5	4.5	0.75 – 1.50	150	1.25
AS-6	18	6	1.50 – 3.00	300	2.5
AS-7	26	7	3.00 – 4.25	425	3.5
AS-8	34	8	4.25 – 5.50	550	4.5
AS-9	42	9	5.50 – 7.00	700	5.5

Installation

The AquaSwirl™ Concentrator is delivered to the job site ready for inspection and use. Typical installation steps include preparation and excavation of the installation area. The swirl concentrator is made of lightweight HDPE, which can be offloaded without the need of special lifting equipment. The AquaSwirl™ Concentrator includes inlet and outlet stub-outs, which connect to existing piping to ensure correct inlet angle, and all connections are typically joined by heat fusion. No pretreatment is required for the AquaSwirl™ Concentrator.

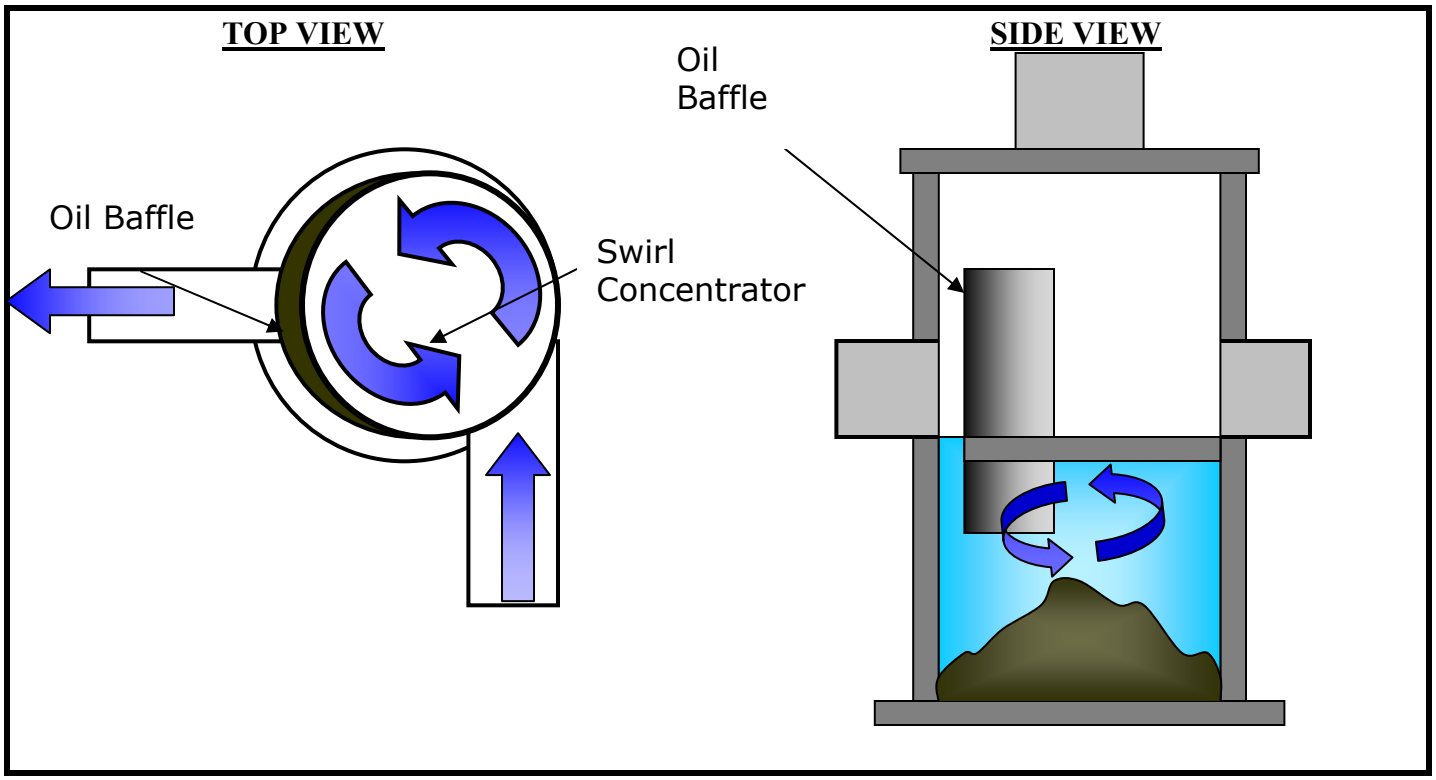


Figure 5.2. Top and side views of the AquaSwirl Swirl Concentrator.

Maintenance

It is important that a routine inspection and maintenance program is established for each unit based on the volume of the contaminants of concern, the frequency of contaminant release at the location, and the nature of the area being drained. AquaShield, Inc. assists customers with establishing an inspection and maintenance program for compliance with stormwater pollution prevention plans.

AquaShield, Inc. recommends that semi-annual inspections of the Swirl Concentrator be performed for the first year of operation in order to develop an appropriate maintenance schedule for the site. Typically, annual cleanout is required in colder climates where sediment loads tend to accumulate more rapidly due to sanding practices.

Swirl Concentrator Chamber Cleanout Procedure:
The AquaSwirl system can be inspected and maintained completely from the surface to eliminate the need for confined space entry. Free-floating oil and debris can be directly observed and maintained through the 28" manhole access provided over the center of the swirl chamber.

Cleanout of accumulated sediment needs to be performed when the useable sediment storage volume has been occupied. Sediment depths can be determined by measuring the distance from the top of the sediment pile to the water's surface by lowering a measuring device, and determining the difference in elevations. Specifically, when the sediment pile is within 24" of the water surface, the system should be pumped clean.

Normally, a high velocity vacuum truck is used to clean the collected pollutants within the system. The vacuum hose is lowered into the sediment pile for its removal.

Aesthetics, Community and Safety

Concerns regarding aesthetics, community support, and safety are highly site specific. For further information refer to Chapter 2, Decision Criteria.

Cost

The average cost of the AquaSwirl™ Concentrator is based on the size of the unit and the treatment capacity. Table 5.7 summarizes the average standard unit costs according to size.

Table 5.7. Average cost of the AquaSwirl™ Concentrator based on standard models.

AquaSwirl™ Model	Cost
AS-3	$7500
AS-4	$9000
AS-6	$14,000
AS-7	$17,000
AS-8	$20,500
AS-9	$28,500

Performance and Verification Ranking

Verification Ranking: **0**

To date there is no available performance verification information for the AquaGuard™ Catch Basin Insert. Contact AquaShield, Inc. for updates in performance studies.

Installation Contact

No existing New Hampshire installations to date.

Location: Essex, Vermont

Contact: Jeremy Matosky
Trudell Consulting Engineers
PO Box 308
478 Blair Park Road
Williston, VT 05495
(802) 879-6331

Manufacturer

Company: AquaShield, Inc.

Address: 2733 Kanasita Drive, Suite A
Hixon, TN 37343

Telephone: (423) 870-8888 or (888) 344-9044

Fax: (423) 870-1005

Website: www.aquashieldinc.com